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THE LONDON WATER SUPPLY AND THE EXTINCTION OF FIRES.

THE question of an increased and purer supply of water for the metropolis has been brought before the Metropolitan Board of Works in the shape of a report prepared by Sir. J. Bazalgette, Mr. F. J. Bramwell, and Mr. Edward Easton, at the instigation, or at all events under the sanction of the Metropolitan Board. The report has been in circulation for some weeks, and, if any steps are to be taken in the matter, it will shortly have to be considered by the Board of Works with that view. So far, the action taken under it may be regarded as purely of a tentative character. The existing supply of water is doubtless not so complete or efficient as it might be, either for household purposes, or for the extinguishing of fires. The scheme advanced by the gentlemen named proposes to provide a special supply, having a pressure sufficient to serve the hydrants for the extinction of fires without the aid of fire-engines, except on the more elevated parts of the metropolis. The reservoirs are to be 400 feet above the Ordnance datum line, and the estimated supply is to be sufficient to provide for a daily provision of two gallons per head. The cost is set down at £5,500,000.

The first question which strikes one in reference to the proposal is: What is really the object of the scheme? Is it to provide a supply of water for consumption purposes only, leaving the present supply for ordinary household purposes; or is it to afford a means of obtaining a supply at such a pressure as shall practically enable us to dispense with fire-engines? Viewed in either light it is a question which very intimately and very seriously affects the interests of the existing water companies. These companies are supplying London with something like 120,000,000 gallons of water per day. The proposal before us goes so far as 16,000,000. It is clear then that the new supply can only, if adopted, be supplemental to that already in use. Whatever the imperfections or wants of that system may be, it must remain. It must be maintained as it is, or subject to the control of the several managements of the companies. The additional supply would, no doubt, if guaranteed, and actually possessing purity, be an enormous boon. But is it probable that people would submit to pay for two independent supplies? This is a question which will, no doubt, occur to many; but independent of it, comes the question of the course which the water companies are likely to pursue should the scheme be approved by the Board of Works. There can be no question but their course will be one of very strong opposition, and a reasonable doubt may be expressed if, even should the Metropolitan Board carry its Bill, whether it will not be subject to compensation to the companies for vested rights, not wholly, but still partially, lost. The supply of pure water should never be begrudged at any cost, but it is questionable if any piece-meal legislation will afford this to the City of London. The fact that the water supply has so much improved in quality of late years speaks well for what might yet be accomplished with a free hand and a determination to seek that end. It is not to be supposed that the source from which Sir J. Bazalgette proposes to draw his water cannot as well supply a hundred and twenty million as sixteen million gallons of water daily, provided the works for doing so are sufficiently extended. Why should not the supply then come from the same source throughout? There can be little question if ever the water supply of London, and indeed of all large cities, is to be what it should be to meet thoroughly the public wants, it must be under public control; and this is what we are fast drifting towards. Sir J. Bazalgette's scheme, if ever brought before a Parliamentary Committee, will meet with such opposition as will either floor it, or force the purchase of the present water supply companies. To buy up these companies would cost four times the sum required to carry out the new proposal; but it would, whatever its cost, be well spent, provided it secured a supply of thoroughly wholesome water sufficient for all purposes, without distinction between drinking or consumable water and that required for domestic purposes.

But now comes the question of fires. Is a supply of water, at a pressure such as shall enable the use of fire-engines to be dispensed with, a necessity? Here, none will begrudge the mede of praise due to our London Fire Brigade—to their indomitable courage, energy, perseverance, skill, and discipline. Their work is frequently one of a very up-hill character. Few will want to be told that every moment is of incalculable value when a fire has hold of inflammable materials—in fact, the first five minutes at a fire are usually worth the next five hours for its subjugation. And yet, what are the means placed at the disposal of our Fire Brigade for acquiring a speedy intimation of fires? It is nothing more than a plain and simple fact to say that in America they would be laughed at. It would be interesting to publish a return of the number of minutes which elapse between the discovery of

fires and the time at which notice of them is received by the Fire Brigade Station. In the first place, we know that with us the simple discovery of the fire has to be the work of some one. It may be that it is by the fireman appointed to patrol the premises; it may be by the policeman on the beat; or it may be by an ordinary passer-by. In nine cases out of ten—or, for that matter, in ninety-nine cases out of every hundred—the fire has obtained a firm hold of the premises ere it is even made evident to anyone. Then comes the notice of it to the fire station or to the nearest police station. Minutes must elapse ere this is done; and then comes the dispatch of the engine and the collection of those in and near the district in which the fire arises. Now let us see how this is done in America. There, of course, they have bought their experience. Built mainly of wood, almost whole towns and cities have been swept away beneath the flames. It is but natural then that their wits should have been sharpened to find out, and to apply, the most perfect and the most speedy means for indicating the presence of a fire. Full well have they learnt the value of every moment in subduing it, and, mistrusting human agency, each building, each room, or as many parts as may be necessary, are provided with thermostats, or heat detectors, which consist of two pieces of metal which, under the influence of any unusual amount of heat, expand and bring into action bells and automatic apparatus of various or of any kind, fixed either in the same house, at the police station, fire brigade station, or elsewhere. The arrangement is such that it gives at once not only an intimation that there is a fire, or that which will lead to a fire, but it also indicates the street, house, or other position from whence the alarm proceeded. To such an extent is this carried that men, engines, and horses are on their way to the spot within a minute of the receipt of the alarm, and that means, it must be borne in mind, within a minute from the time the fire, or the heat caused by it, has increased so far as to excite the thermostat. Now this is nipping it in the bud. With the experience of years, and of no inconsiderable loss from fire, the United States and Canada have gone as far as possible to the root of the evil. With this before us, we hesitate to conclude that the supply of water is the only necessity for the better extinction of London fires. Water certainly is necessary, but water we have; and before more is done in this direction we would suggest that some attention should be afforded to the question of providing a better and more speedy means than we now possess for giving notice of the presence of a fire. Of our Fire Brigade we have reason to be proud, but they are at present scarcely in a fair position to deal with fires, except under an initial loss. To be on the spot five minutes earlier means very much more than the subjugation of the fire five minutes sooner. It means the saving of—it may be—a vast amount of property. A little fire can always be commanded, but a big fire hardly so easily. The great thing then is, to get such early notice of all fires as shall prevent any one of them becoming anything more than a little fire. Our present system does not admit of this, and to this fact we commend the attention of the Metropolitan Board of Works when dealing with this question of water supply.

THE DETERMINATION OF TEMPERATURE CO-EFFICIENTS FOR INSULATING ENVELOPES.

By THOMAS T. P. BRUCE WARREN,*

Analytical Chemist to the India-Rubber, Gutta-Percha, and Telegraph Works Company.

Of all the phenomena connected with insulators, there is not one which demands more careful consideration than the changes brought about by variation of temperature; yet I am not aware that any writer on telegraphy has devoted more than the bare space required for the enunciation of the fact that the insulation of telegraph cores is increased or diminished by the rise or fall of the thermometer.

It is with the view of directing the attention of electricians and telegraphists to a few subjects in this department of the science of practical electricity, and which are but scantily dealt with, even in the latest and most complete works on the matter, that I have thought the present paper a suitable one for the commencement of a series on the practical bearing which certain physical and chemical facts have upon Telegraphy.

From the circumstance that telegraph cores have a high or lower resistance according as their temperature is low or high, the lengths and thickness of the insulator remaining the same, we are necessitated to refer whatever tests are made for insulation to some fixed temperature, and for this purpose we are supplied with a table of co-efficients for this correction; so that, knowing the value of an insulating covering in megohms per nautical mile, or any similar standard length, we can ascertain what will be the effect of raising the temperature any number of degrees above that at which our observation is made, or conversely if the required temperature is below that at which our test is made.

The temperature which is now by common consent taken for this fixed reference of results is 75° F. The advantage of this temperature is, that it can always in practice be readily obtained, either for the purpose of direct observation, or for the verification of *the modulus of conversion*.

By the term *modulus of conversion*, I mean the root or radical number which expresses the ratio between the insulation resistance of any insulating covering for differences of one degree on the scale of Fahrenheit.

This modulus, from all we can tell at present, is

* Communicated by the Author.

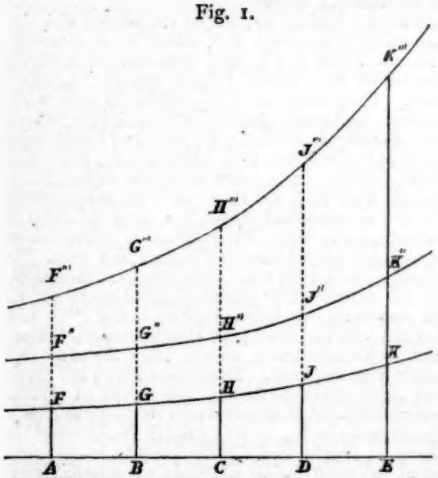
unaltered so long as the chemical or structural condition of the insulator remains unaffected. An exception to this statement is met with in gutta-percha cores, for Mr. Willoughby Smith has pointed out that cores whose diameters exceed a certain value, require a different number to those whose diameters are less; but it will be necessary to say more on this as we proceed.

The rate of variation in the resistance of an insulator due to temperature was, as far as I am aware, first pointed out by Professor Fleeming Jenkin (see Report of Commission on Telegraph Cables, &c.). The first application of its principle to actual practice was made by Mr. Latimer Clark and Sir Charles Bright on the cable made for the Indian Government, which was submerged in the Persian Gulf.

The author made a very extensive examination of the effects produced by changes of temperature on the form of insulated wire made by Mr. Hooper, and in a paper which was presented to the meeting of the British Association at Nottingham, in the year 1866, on the electrical properties of this core, the effects of temperature were so clearly explained that I extract from this paper the following general enunciation, which is applicable to all insulators, and from which the curve may be plotted for any core.

Representing as the unit of temperature, one degree on any thermometric scale, we measure on the horizontal line the equal spaces corresponding to equal thermometric increments, and on the points so obtained we erect the perpendiculars increasing in length in a geometrical ratio, found by dividing the resistance obtained at any temperature by the resistance determined at the next succeeding or preceding thermometric increment or decrement; consequently, to determine the resistance at any required

Fig. 1.



emperature, we have to raise the ratio obtained between the resistances found for two successive observations to that power which expresses the units of thermometrical increments or decrements; this product multiplied into the initial resistance will be the reciprocal of the resistance at the required temperature. By this process we obtain an expression which plotted out gives a logarithmic curve.

Professor Fleeming Jenkin had before this graphically represented the effects of heat on gutta-percha by a logarithmic curve, so that, although he did not give us a formula which admitted of general application, he at least indicated the method for its mathematical development.

A few words may be said here on the properties of this curve, and the relation of certain of its properties towards the phenomena we are now discussing.

The logarithmic curve.—If on an indefinite line, AL, the parts AB, BC, CD, DE, &c., be taken equal to each other, and ordinates AF, BG, CH, &c., be drawn perpendicular to AL, and in lengths varying in a geometrical progression, the curve FHK, which passes through all their extremities, is called the logarithmic curve. The axis LA produced is an asymptote to the curve; for since the terms of a decreasing geometric series never can become equal to nothing, any ordinate distant from the origin in the direction AP can never become nothing. Since, however, it becomes less and less, the curve approaches nearer and nearer to the indefinite line.

In the other direction it is also obvious that the curve may be continued *sine limitê*.

To apply these considerations to the varying condition of an insulating envelope under the action of variable temperatures, the initial ordinate AF may be drawn to represent either the resistance which we obtain on starting, or better still, by representing the value of this as unity make AF equal to 100 mm. if it is required to draw a large diagram. It will be necessary to keep this as small as we can, however, since its successive expansions will give dimensions for our ordinates unmanageable for graphic illustration. We have then to draw BG, which is to represent the value at the next temperature point. The resistance at A temperature, divided by that found at B, if this difference is 1° F. is the modulus or co-efficient for 1° F., if the interval be 10° F., or any other number of degrees, we obtain the modulus for 10° F. or whatever may have been the differences in the temperatures. Multiply this ratio into 100, and draw BG in mm. corresponding to the product; in the same way we may proceed with the results of all the observations.

It is obvious whatever low degree of temperature we may take A to represent, we can always conceive of lower ranges of temperature, consequently we can extend the ordinates on the left-hand side of our initial experiment; but since however low we carry this temperature the resistance can never become absolutely perfect, for then we should obtain ordinates equal to nothing; these ordinates may become as small as we please to make them, but we can conceive of their being reduced much smaller. In the same way we may get our insulation by reduced temperatures as high as we please, but so long as we can conceive of lower temperatures so we must assume there is no limit to which our insulation can attain. In the other direction, the ratio can be expanded without limit; but we all know for certain that organic substances cannot be heated without change taking place at some temperature or another; consequently we obtain a limit here, not because the law itself ceases to hold good, but from the fact that we have imposed a condition on our insulator which

no longer allows it to form a fit subject for mathematical investigation, for our fundamental premises are that no chemical or mechanical changes can be assumed or dealt with. Theoretically, an insulator may by heat become lower and lower in resistance, but so long as it is not burnt, melted, or decomposed in any way, we can always conceive of a temperature at which the resistance may still be lower. A figure may be obtained for the value of an insulator at the melting point of copper, and, as far as we can see, if india-rubber or gutta-percha could stand such a temperature unaltered, there is every reason to believe that the law of variation would be unaltered.

The reader will observe from what has been said that we are representing diminishing values by increasing lengths of ordinates. This is necessary, because we are so much in the habit of speaking of resistance in insulators instead of conduction. These ordinates accurately represent the conduction of the insulators, or the reciprocals of their resistance. In this there need be no confusion if we keep these few remarks before us.

By the nature of logarithms, any abscissa A D is the logarithm of the ordinate D J, in a system which depends upon the magnitude of A B and B G, the part A B being given.

Let A B = 1, the logarithm of B G, then if B G = a, A D = x, D J = y, then 1 : x :: log. of a : log. of y, but 1 = log. of a, $\therefore x$ = log. of y; that is, $x \times 1$, or $x \times$ log. of a = log. of y $\therefore y = a^x$, which is the equation to the curve.—(*Dealtry's Fluxions.*)

Now, by construction, we have made A B, B C, C D, &c., to represent the increments of temperature for 1°, 2°, 3°, &c., so that B G = log. of 1, C H = log. of 2, or 1 + 1, D J = log. of 3, or 2 + 1, &c.; the base a of the system being the ratio between any two resistances for the corresponding differences in degrees of Fahrenheit's thermometer.

With Mr. Hooper's form of insulated wire I find the value of a = 1·026, so that making A B = 1·000, B G = $1{\cdot}026^1$, C H = $1{\cdot}026^2$, D I = $1{\cdot}026^3$, &c., &c. We may find as many points of curve as we please in the direction A L; from A in the direction A P, we have to proceed in a similar way, except that our indices will have a negative sign, so that instead of expanding 1·026 we have to extract the roots corresponding to the same differences of temperature, or if we divide A B by B G we shall also obtain the length of the ordinate in the opposite side of A in the direction B A for 1° F. below that represented at A.

A negative sign will also appear in any case where the temperature T is lower than that to which we have to convert the resistance, according to the algebraic sign of T—t we have to multiply or divide by the co-efficients for the differences of temperature; thus, if we have to convert from 70° to 75° we divide the resistance at 70° F. by $1{\cdot}026^5$, whereas if the conversion is from 70° to 65° F. we have to multiply by $1{\cdot}026^5$.

The tables of temperature co-efficients are simply the ratios for differences of 1° expanded. From what has been said the reader will see that if the modulus has been obtained by testing at intervals of 10° or 3°, he must extract the 10th or 3rd power for the ratio corresponding to 1°.

If the temperature variations of different insulators, each having different rates of variation or values for correcting, be plotted on the same diagram, a straight line drawn parallel to the axis of x through these curves will connect the points at which the resistances are all equal, so that we can tell at what temperature one insulator may be heated to correspond with the resistance of another insulator.

In india-rubber cores different degrees of vulcanisation will give a different modulus, and some pigments incorporated with it, particularly the sulphide of lead, will increase the same to 1·046 for 1° F. I hope at a future time to consider some of the conditions under which these co-efficients are affected by changes in india-rubber cores.

Since we are able to plot a curve, which not only graphically represents the condition of an insulator under changes of temperature corresponding to one minute's electrification, but which, making due allowance for the errors of observation, agrees mathematically with the results, I can see no reason why the same should not hold good for any number of minutes' electrification, so long as the insulator itself remains chemically unaltered. It will no doubt be extremely difficult to eliminate the factor due to electro-chemical changes, which we know must occur, especially under a very protracted electrification; and on this account, for a careful investigation of temperature effects, it will be safer to deal with as short periods of contact as possible. One decided advantage of this is obvious, for we are less liable to introduce errors arising from variation in the testing arrangements, battery, and so on.

The results which I have obtained on india-rubber are said not to hold good with gutta-percha. However, I hope to show in this paper that there is a better agreement than is generally believed; in fact, my results not being appreciated appears to me to be due to a wrong interpretation of the experimental data, and for which I am perhaps to be blamed for not correcting it earlier.

As all my readers may not be acquainted with the modes and precautions with which these measurements are made, I will here describe the methods adopted by Sir Charles Bright and Mr. Latimer Clark. Four coils of gutta-percha-covered wire, each measuring one nautical mile in length, which were manufactured for the Persian Gulf Cable, were placed in a felted iron tank holding 1,200 gallons of water. At the commencement of the experiments, the coils were kept for three days in water which was well agitated, and in which a large quantity of melting ice was kept. This precaution was to insure the uniform temperature of the tank and core. At the end of this time the resistances were measured, and the temperature gradually raised up to 38° C. The resistance was determined for every 2° C., and after the coils had been kept at each respective temperature for a sufficient time to allow the even and certain heat required. The values which are given from these experiments are the means of several observations, which extended over thirty-three days.* The expression $R_{t_1} = R_t\,(0{\cdot}8944)\,(t_1 - t)$ which is known as Bright and Clark's formula, is certainly one of the most useful additions to practical telegraphy.

It is not, however, necessary to start from any fixed temperature. I have invariably taken as the initial temperature, for any series of tests, that at which I have found the coils after leaving them at

* Sabine's Electric Telegraph.

rest and covered up for a few days. It is important that the temperature be not too quickly raised. I have generally used differences of 3° F.; these smaller differences are more likely to be evenly distributed than larger ones, and further enables a test to be made within a shorter time than would be possible with greater ranges of temperature.

As far as is compatible with the certainty of uniform distribution of the heating, I would advise making the intervals between the testing as short as possible, and for very great degrees of accuracy it is safer to proceed first with differences of 1° F., and noting the resistance at the end of some hours, then carefully earthing the core for a repetition test at the end of a similar number of hours. The results being constant, the temperature is then altered for another degree, and so on. Ten measurements being made in this way with differences of 1° F., or a little more, but not exceeding 3° F., it is next advisable to proceed with differences say of 10° F., so as to make sure that sudden greater changes of heat do not follow a different rate of variation, for the author has found that this is by no means a matter undeserving of attention.

The temperature should now be carried as high as may be required, but the higher, so long as the insulator is not damaged, the better. The last test should be verified by repeated testing, and then the core cooled down as quickly as the water will part with its heat to the initial temperature; if the range of the temperatures have been very wide this will require some days, but when certain that the temperature is quite even and correct a final measurement is taken.

This precaution must not on any account be neglected, for by obtaining the same values at the beginning and end of the experiments affords us an undeniable satisfaction in the numbers we obtain. The core selected for these tests must not be too new; it will be better to experiment on a core which has been made a few months, so as to avoid any error which the improving condition of the core by age would entail.

The frequent agitation of the water must be attended to whilst the temperature is being changed, and, although the advice may appear needless, a good thermometer, compared with a standard frequently during the tests, should be employed. The standard itself may be left in, but the danger from stirring the water must be avoided.

To make quite certain that the thermometer indicates the temperature of the core throughout, the copper resistance should invariably be measured with each set of observations.

The best plan is to tabulate the calculated resistance of the conductor from the measurements at the start of the experiments for every succeeding stage of heating, so that by comparison between the figures obtained and the calculated resistance we can ascertain that the heat has been uniformly distributed. I have generally measured the copper resistance twice during the time of raising the temperature from one stage to another. In this way I found that eight hours were sufficient for differences of 1° F. to be uniformly distributed through an insulating covering of india-rubber ·3" thick with a small conductor.

The thickness of an insulating envelope and the weight or mass of copper in the conductor have important influence on the rate of distribution, but sufficient time must be given to make sure that no error is incurred from these circumstances.

The number of cells employed must not be greater than is absolutely necessary where accuracy is the only thing sought after, as we avoid, or rather tend to reduce, electrolytic action.

It is well known to the chemical physicist that very weak currents are capable of affecting decompositions; and in the study of substitution results, electricity by discharge is an important aid to the chemist.

In testing gutta-percha cores we must not overlook the fact that Stockholm tar contains some of those very interesting hydro-carbons which at present are engaging the attention of chemists for the production of dyeing materials by electrolysis. I therefore feel disposed to question the suitability of gutta-percha cores for the purpose of a purely scientific examination of the phenomena of electrification, but in saying this my readers must not understand that I repudiate the practically good qualities of this substance as an insulator.

The Stockholm tar contained in the compound for uniting the layers of gutta-percha may account for the difference which has been given by Mr. Willoughby Smith in the two co-efficients for different sizes of cores.

A few years ago I read a paper in the Chemical Section of the British Association at Dundee, on the "Electrical Resistances of the Fixed and Volatile Oils." Some results I obtained appeared to me at the time so unconnected with what I had in hand that they were not alluded to in the paper with more than a passing remark, but I feel confident that in connection with the present subject these discarded phenomena are of some importance. The reader who would feel an interest in reading this paper will find the same printed *in extenso* in the Report of the British Association, the Chemical News, Pharmaceutical Journal, and Transactions of the British Pharmaceutical Conference.

From my experiments it is certain that some good liquid insulators become, under the influence of electrification, and in contact with metals (the more easily oxidisable), rapidly conducting, so that prolonged contact indicates the anomalous result of diminished rather than increased resistance. Turpentine and cotton-seed oil, which for a few moments after contact are very good insulators, are, when in contact with brass and electrified with 100 cells, converted into highly conducting media. The oils of lavender and peppermint, on the addition of a few drops of turpentine, behave in the same way. Olive oil, which electrifies very well, exhibits the contrary action when a little cotton-seed oil is added to it.

I mention this to show that certain tolerably good insulators do, under the action of prolonged contact, comport themselves in a way different to what our notion of insulation would lead us to expect, so that in examining the phenomena of electrification we must not overlook the changes which are likely to arise in the constitution, chemically or otherwise, of the material to be tested.

A few words on testing at very low temperatures for temperature co-efficients.

In determining temperature co-efficients enough

has been already said to show that we must avoid any treatment which by altering the condition of the core may introduce new factors, and thus vitiate the whole experiments.

When a core is cooled down to 32° F., and kept so for some days, it is well known that it improves beyond what we can infer from the effect of the temperature alone. The contraction of the core and the freezing of india-rubber are conditions we cannot avoid, since india-rubber (unvulcanised) hardens at 40° F. It is not improbable but that gutta-percha at these low temperatures may undergo similar changes, though not in an equal degree. In its physical structure or condition, however, the effects of Stockholm tar on gutta-percha must not be left out of our account. The effect of Stockholm tar on india-rubber is very marked at temperatures above 40° F., and in fact at 70° to 80° F., if much tar is present, the fall in the insulation resistance of a core may be so great, from the absorption of some of its proximate principles, probably, as to cause serious perplexities. Can we assume that in gutta-percha cores an immunity exists for the tar mixed with it in the union compound? and some of which is in actual contact with the conductor. The great softening produced by heat is well known.

The best plan will be, from what has been said, to keep the range of temperature between such limits which will keep the core free from great disturbance in its character, when the experiments are to be carried out for obtaining results for scientific generalisations; but in practice it is also necessary to know the effects of temperature for all possible changes of heat.

To Sir Charles Bright and Mr. Latimer Clark we are also indebted for the idea of testing telegraph cores in water heated to 75° F. There are many reasons why this temperature is the best suited to manufacturing purposes: in the cold weather it is easily kept up by heating the water, and in the warmest part of our summer it is even more easy to keep up this degree of heat in a large quantity of water. Apart from these considerations is its immensely economical recommendation in labour and cost. A much lower temperature would of necessity entail the taking of precautions to cool the water down, and a much higher temperature would necessitate a greater consumption of fuel. It is much cheaper and easier to raise the temperature of water—say, from 60° to 75° F., than it would be to cool the same down to 45° F.

Still, I cannot help thinking but that the testing of cores at a lower rather than a higher temperature would give a greater security against passing over small faults.

Information is wanting as to the effects of temperature on faults. My experience on the behaviour of faults is, that the lower temperature will frequently show a suspicious indication, which at a higher temperature is lost altogether, from the fact of a small leakage, which remains nearly constant at all low temperatures, being swamped, so to speak, by the increased leakage of all the sounder parts of the core.

It was from testing cores at very low temperatures that I was forced to determine a method for cutting out very minute faults. In the earlier days of testing I very frequently had to wait from thirty to sixty minutes to ascertain on which of the two insulated drums the fault existed, especially if the weather was very warm. In the winter and cold frosty weather five minutes would have been ample time. A Columb torsion electrometer, as modified by Mr. Latimer Clark, was the instrument used, and charged so as to repel the pith balls through an arc of 60°.

To enlarge on the utilisation of this fact for determining the freedom of a core from defects would require more space than this article will admit, and detract too much from the matter in hand, so I hope to make this the subject of a separate paper at an early period.

The method adopted for testing and comparing the copper resistances for changes of temperature, so as to verify the thermometer indication in testing for temperature co-efficients of insulators, will be given in a future paper "On Testing Copper Wire."

The next portion of the subject will treat of the temperature co-efficients for periods of contact greater than one minute, and the phenomena of electrification.

ELECTRICAL APPARATUS TO INDICATE OVERSTRAIN OR WEAKNESS IN BRIDGES OR OTHER STRUCTURES.

THIS invention, patented through the Scientific American Patent Agency, by Mr. John Forbes, of Dartmouth, Nova Scotia, relates to certain means of obtaining a prompt indication of the unsafe condition of such structures as bridges, roofs, etc., when such unsafe condition is caused by overloading or undue or excessive strain of any member or of the whole structure, or by derangement of parts at joints or connections, or by any change of condition, either sudden or gradual, from that under which the structure was designed to serve.

In the case of a bridge, for instance, the various members of which are subjected to either tensile or compressive strain the several proportions of such members are so adjusted as to afford a determined margin between the ultimate breaking load or strain and the greatest load or strain to which such member is intended to be exposed under traffic or use. This margin may be reduced by various causes, as the passage of an excessive load, a sudden jar produced by slight obstructions to, or perhaps partial derailment of wheels, breaking of flanges, etc., or within the structure itself, loosening of rivets, gradual weakening of the member under frequent repetitions of the load, imperfect workmanship, flaws in the material or errors of calculation not apparent at the time of erection. Such lessening of the margin of safety need not be fatal to the structure, provided it can be detected and suitable remedial measures promptly adopted, and the originally designed margin of safety obtained.

In the case of members exposed to tensile or compressive strain no permanent injury will result until the limit of elasticity of material is exceeded. Indication of overloading will be recorded before this limit has been reached.

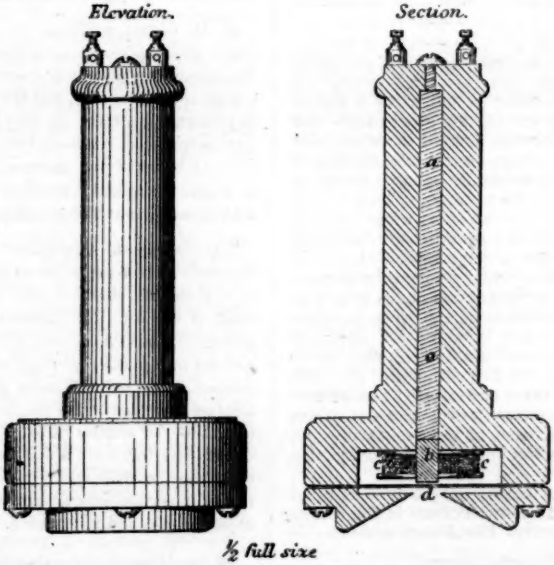
In the case of dislocation or derangement of parts, as the slipping out of position or shutting by of butted joints—as in upper chords, or vertical

posts, or oblique struts—in all such and in all similar or analogous cases, it is the object of this invention to furnish a ready means of obtaining a direct indication that such overstrain or derangement has taken place, although no permanent set or immediately apparent evidence may have been left upon the member or structure itself.

The invention consists in attaching upon each member of the structure an insulated wire or conductor, so arranged that an electric circuit may be made or broken, by any convenient mechanical means, by the abnormal condition resulting from the excessive strain or dislocation of parts, from whatever cause it may arise, through which a motion either in the substance of the member itself or between contiguous and adjoining members has taken place, the closing or rupture of the circuit to be indicated by an annunciator, operated by the electric current from a battery through electro-magnets suitably arranged, the armature of the magnets being so adjusted that, as in the case of hotel call-bells, a number or indicator shall be exposed, said number to indicate a particular part or member of the structure.—*Scientific American.*

THE TELEPHONE.

NOTHING perhaps strikes one more than the extreme simplicity of Professor Bell's articulating telephone, an exact representation of one form of which we give in elevation and section. It was this form which was exhibited by Mr. Preece at the British Association meeting at Plymouth, and which excited such wonder and curiosity.



½ full size

The instrument outwardly somewhat resembles the mouthpiece of a speaking-tube, and is about the same in bulk.

Internally it consists of a diaphragm (*d*) of thin iron plate, the surface of which is in close proximity to the soft iron prolongation (*b*) of a permanent steel magnet (*a a*). A small bobbin of silk-covered copper wire, of about No. 38 gauge, encircles the soft iron core (*b*), the ends of the wire being attached to terminals at the upper end of the instrument. This constitutes the whole of the working part of the apparatus, and nothing can well be simpler.

The instruments at both the sending and receiving ends of the wire are identically the same, and it is usual to employ them in pairs, so that one can be placed to each ear, and the articulation thus be rendered more evident to the sense.

The articulation, although comparatively faint, and possessing a kind of metallic ring, is very distinct and clear, and conversation can be carried on with great facility by placing the mouth close to the opening of the instrument when speaking, and against the ear when listening.

RESISTANCE OF WIRES.

THIS is a subject on which several series of researches have been made, but the results have been discordant. Thus MM. Becquerel, Siemens, and Matthiessen, with comparatively good agreement, have found in the case of copper, silver, gold, iron, and platinum, a diminution of resistance through annealing. M. Mousson, on the other hand, in the case of steel wires hardened by extinction, also obtained a decrease of resistance through the softening; but in steel wires, which were hardened by drawing, as also in copper wires, he got an increase of resistance through annealing.

With a view to explain this discordance, and to

examine the behavior of a large number of metals, M. Chwolson, of the St. Petersburgh Academy, has investigated the action of softening through annealing (either by means of a strong electric current or a gas flame) on the galvanic resistance of hard-drawn wires of 15 different metals—namely, platinum, platinum-iridium, palladium, aluminum, aluminum-bronze, iron, steel, copper, brass, German silver, zinc, silver, lead, magnesium, and cadmium. The last of these gave no distinct results, whereas, in the case of all the others, the question was answered unequivocally. We will not here further describe M. Chwolson's method, but merely give the results of the measurements in the following table, in which under A is represented the maximum of the observed change of the resistance in consequence of the first glow; under B the maximum of the resistance-change at a strong glow; and under C the greatest change of the resistance at extinction, all explained in percentage of the original existence of the hard drawn wires:

	A.	B.	C.
Steel	—4·8 p.c.	+8·6 p.c.	+0·6 p.c.
Iron	—0·4	+5·3	+0·7
Brass	—8·3	+0·8	+1·0
Copper	—2·9	+1·4	+0·4
Platinum	—5·3	+5·8	+0·7
German silver	—1·1	+2·0	—1·8
Aluminum bronze	—8·0	——	+2·7
Palladium	—0·4	——	+0·1
Platinum-iridium	—3·2	——	+0·3
Silver copper alloy	—11·3	——	+1·7
Zinc	—1·8	——	——
Aluminum	—1·9	——	——
Lead	+0·5	——	——

We see from this table that, in the case of twelve out of thirteen metals, the galvanic resistance is diminished in the softening of the wires in consequence of the first not very strong glow; only lead forms an exception, showing a slight increase. On increased and strong glow, six metals showed a distinct increase of the resistance; consequently an effect opposite to that of the softening. This double action of glow, in the case of some wires—for example, iron—where the decrease through softening is slight, and the increase through increased glow is strong, can only be observed by very careful measurements. That the second action is not simply to be attribted to an oxidation of the wire, is shown clearly by the high value obtained for platinum (with strong glow the resistance again rose above its original amount), and the comparatively very small value found for brass and copper. In extinction of the wires in water, lastly, nine out of ten metals showed an increase of the resistance, and only brass (German silver?) showed a considerable diminution of it.

The double action of annealing here demonstrated sufficiently explains the contradictions in the results of previous investigators.—*Der Naturforscher.*

Notes.

THE novel plan for reading the scale of the reflecting galvanometer by daylight, which we described in the last number, is, we believe, due to Mr. Den Smith, of Cambridge.

THE governments of the Australasian colonies have jointly engaged a steamer to run between Ranjoewargie and Port Darwin, should the telegraph cable at any time break down.

THE National Telegraph office in Santa Fé (Buenos Ayres) received and despatched, we are told, 2,255 messages during the month of July. The revolution kept the wires more active than usual in the Government service. "It is an ill wind," &c.!

IN 1777, a hundred years ago, the first lightning-rod was set up in Germany by the recommendation of Prof. Sulzer and M. Gerhard, on the Magazine of Military Equipments, Berlin. At the present time there is, we believe, a ministerial order declaring the application of lightning conductors to German government buildings as unnecessary. In France every public building is protected.

DR. BÖRNSTEIN has found that the property of experiencing diminished electrical resistance under the action of light is not confined to the metalloids selenium and tellurium, but belongs also to platinum, gold, silver, and probably to metals in general. He also states that the electric current diminishes the conductivity and the sensitiveness to light of its conductor, and that both of these, after the current has ceased to flow, gradually regain their former values.

M. B. FELICI publishes an interesting experiment made with a plate of aluminium and a plate of glass. The aluminium plate was suspended horizontally from a long, thin silver wire, and the glass plate was caused to revolve beneath it. As long as the aluminium plate was unelectrified, it followed the glass plate very feebly by the friction of the intermediate air. But as soon as it was electrified it revolved twice or thrice on its axis in the direction of revolution of the glass disc.

THE friction of a metal on a di-electric generates electricity. If a metal bar is drawn across the surface of a di-electric, electricity of a certain kind marks the track of the bar. To discover the kind of electricity generated, Dr. Guthrie and Mr. Akroyd dusted sulphur and red lead powder mingled over it in the well-known manner. The red lead being positively electrified collects on the trace of the bar, if the electricity is negative, and the sulphur if it is positive. Dr. Guthrie thinks that this test, which he calls "electrical selection," may be made useful in the electrical diagnosis of metals in certain experiments where electrometers are objectionable, and in teaching.

M. DU MONCEL, from considerations of theory verified by experiments, has determined that the maximum magnetic effect is obtained in an electro-magnet when the thickness of the coil is equal to the thickness of the core.

ARRANGEMENTS have, we hear, been entered into between the Western and Brazilian and the Telegraph

Construction and Maintenance Company for the repair of the Para-Pernambuco cable (interrupted since February, 1876), and for the establishment of communication with Maranham, an intermediate coast town not hitherto on the company's cable system.

MR. SCOTT STOKES has reported favourably on the possibility of laying a cable along the coast of Chili, and the Minister of the Interior has asked for an estimate of expenses for a cable between Lebu and Punta Arenas, with intermediate stations at Corral and Chiloe.

THE steamships *Seine* and *Hibernia* have returned to Berehaven without succeeding in repairing the 1865 cables. The pieces picked up were found not in a very good condition. It is unlikely that further attempts will be made to repair it this year. The *Minia* is at work on the repair of the 1866 cable, and either the *Seine* or the *Hibernia* will probably assist her.

MR. EDISON'S original discovery that the friction of a metal style on certain chemically-prepared paper is remarkably diminished by the passage of an electric current from the style to the paper, is well-known, and has been justly admired. It is interesting to note something very similar in an English patent, No. 3663 (Muirhead), 1873. A clause in this patent runs as follows:—"Sometimes in place of marking by means of ink I employ a chemically-prepared paper and a metal capillary tube dipping into a solution of caustic potash. *By passing a current from a battery through the paper, the resistance to motion of the point of the tube on the paper is diminished.* The current from the battery also assists the flow of the liquid through the tube."

THOMSON AND JENKIN'S CURB-SENDER. — A considerable number of these instruments have now been supplied to the different submarine telegraph companies; and, as an instance of their efficiency, it was recently announced by the Western and Brazilian Company that they could now work through their whole length of cable without re-transmission — a clear and evident saving not only of staff but of time — an element of possibly more importance to those using the cable. The introduction of the instruments just spoken of, combined with the recently-introduced system of duplex system, as now used by the Eastern Company, undoubtedly mark, we think, a distinct era in submarine telegraphy, as interesting to shareholders as it is to the many concerned in speedy communication with far distant lands.—*Glasgow Herald*, Sept. 14th.

MUSCULAR contraction, it is known, is always accompanied by electric phenomena. The difference of electric potential between two points of a muscle undergoes a diminution, which, according to Bernstein, precedes by about one $\frac{1}{100}$ of a second the contraction of the muscle. This electric variation has been observed on various muscles, and in particular on the heart (by Du Bois Reymond and Kühne), and recently M. Marey has represented it graphically by photographing the indications of a Lippmann capillary electrometer. The *Journal de Physique* states that M. de la Roche has tried the experiment on the heart of a living man. Two points of the epidermis of the chest were connected with the poles of a capillary electrometer, by means of electrodes formed each of a bar of amalgamated zinc, with a plug of muslin at its lower end saturated with sulphate of zinc. Held by insulating handles the bars were applied, one with its plug opposite the point of the heart, under the left nipple, and the other to another point of the chest. The mercurial column was then seen to execute a series of very distinct periodical pulsations synchronous with the pulse. Each pulsation even marked the double movement of the heart (of the auricles and ventricles). The amplitude corresponded to about one $\frac{1}{1000}$ of a Daniell cell. —*Scientific American.*

THE West Coast of South America Cable, from Callao south, has been broken, it is thought, by earthquakes.

A CORRESPONDENT writing in *Nature* for August 30th, draws attention very opportunely to the following extract from Count du Moncel's "Exposé des Applications de l'Electricité" (1857): "I did not wish to bring forward in the chapter on the electric telegraph a fantastic conception of a certain M. Ch. B——, who believes that it will be possible to transmit speech electrically, because it might have been asked why I had classed among so many remarkable inventions an idea that, presented by the author as it is, is not more than a dream." M. du Moncel then describes M. B——'s conception. "Imagine that one speaks near a mobile plate, flexible enough not to loose any of the vibrations produced by the voice, that this plate establishes and interrupts successively the communication with a battery. You would be able to have at a distance another plate which would execute at the same time the same vibrations. It is true that the intensity of the sounds produced would be variable at the point of departure where the plate is vibrated by the voice, and constant at the point of arrival where it is vibrated by electricity. But it is demonstrable that this would not alter the sounds."

THE Russian Government, it appears, is turning its attention to the electric light as an illuminator for military purposes. In some experiments recently made at St. Petersburgh, with the special object of increasing the distance to which the light produced by electricity may be thrown, it was found that the power of the light is greatly augmented by covering the carbon burner with a thin sheet of copper. The augmented light was sufficiently powerful to render objects visible at night at a distance of upwards of 3,000 yards.

THE telephone has been put to a practical use in New York. There are five wires in operation. The piers of the new Brooklyn bridge are connected with the superintendent's office, so that all the movements of the "travellers" in carrying the wires are communicated and directed by the telephone instead of signal flags previously used.

SOME months ago, Dr. Upham, of Salem, Massachusetts, in order to explain to his audience the variations of pulse in certain diseases, caused the lecture-room to be placed in telegraphic communication with the city hospital of Boston, distant fifteen miles, and by means of special apparatus the various pulse-beats were exhibited by a vibrating ray of magnesium-light upon the wall. These experiments have lately been repeated at Paris with success.

M. TIVEYRAT proposes to protect the portions of telegraph poles which are buried in the earth by sleeves of galvanised iron about 0·4 inch in thickness, covered with tar or red lead. The sleeves are imbedded in the wood of the post, and extend somewhat above the ground. Tar is applied to the upper joint so that no water can enter between the sleeve and the wood, and the lower part of the former is bent over the bottom of the post, and covered with an iron cap.

ON August 14th, the Danes, who love to do honour to their great men, celebrated the centenary of Oersted. Hans Christian Oersted was born on August 14th, 1777. In 1819 he discovered electro-magnetism, and awoke one June morning to find himself famous. Last June a statue was erected to his memory in Copenhagen at the university of which he was a professor. A copy of the classic paper in which he announced his great discovery has just been added to the library of the Society of Telegraph Engineers. It is written in Latin.

THE exterior of the Paris International Exhibition building has been completed. The space allotted to Great Britain has been given in charge of the architect of our Government.

WE learn from *Engineering* that Mr. W. J. Cracknell, Superintendent of Telegraphs, Queensland, has recommended the Queensland Government to assume the whole responsibility of laying a cable from her northern coast *via* Macassar and Singapore to Bankok, in Siam, so as to complete a second and independent line to Europe.

THE great rival telegraph companies of the United States—the Atlantic, and Pacific, and Western Union Telegraph Companies—have at last come to an agreement for co-operation in the future, which took effect on August 21st. The two companies will continue to work their lines independently as heretofore, but the joint receipts will be divided in the proportion of 12½ per cent. to the Atlantic and Pacific, and 87½ per cent. to the Western Union.

IN the number of this JOURNAL for August 15th it is stated that "forty-five cables are worked independently by the St. Petersburgh Telegraph Company." This should have been—"Forty-five cables are worked according to the regulations adopted by the International Telegraphic Convention of St. Petersburgh."

THE west and north upper walls of the American Patent Office building at Washington were destroyed by fire on Tuesday, 24th September. From fifty to seventy-five thousand models were consumed in the flames. Some of these were models of the most important inventions extant, but the majority were stored up as rejected models. Some valuable drawings and records were also burned; but in a lower storey both models and records were saved. All offices subordinate to the department of the Secretary of the Interior, except the Pension Office, were located in the same building. Their documents were saved, but in a state of serious confusion.

City Notes.

Old Broad Street, Sept. 29, 1877.

THERE is a lull in the city so far as telegraphic matters are concerned; but a lull—we warn Mr. Pender and his friends—which will be of brief duration. The amalgamated Indo-European and Eastern Companies may have peace, and the United Anglo-American and Direct United may enjoy their own way—for a time. Yet discomposing signs are already discernible. If it be true, as the leading American paper states, that a company has been formed to connect San Francisco and Japan by a new and direct cable, 6,000 miles long, and also to lay a new cable direct between New York and France, it is obvious that the Anglo-Direct combination will have to face competition sooner or later. If it be also true that permission has been granted to the scheme in question by the French Government, and a very complete estimate of the cost has been prepared, there can be no doubt—first, that the scheme is supported in most influential quarters; secondly, that the originators of it mean to lose no time and spare no efforts to carry out their intentions: *ergo*, when they have once succeeded in laying a cable between New York and France, they will certainly take steps to increase their income by placing means of cable communication with America at the disposal of persons residing in England on more advantageous terms, of course, than the existing companies offer. Meanwhile, the sword of Damocles still hangs over the heads of the Anglo-American and Direct shareholders, the American Government may any moment insist upon the removal of the Direct cable from its shores. We are well aware that the speculators who lured the Direct Company to what we are afraid will prove an evil fate, continue to assert their belief that the American Government will not follow up its expostulations by action. But we happen to know all the same that even the speculators are uneasy. They have, thus far, gained their ends; but they have other operations in view, and they not unnaturally conclude that if the American Government should determine to eject the Direct cable from its shores the consequences may be such as to imperil

their plans for the future. Strange as it seems to those who are behind the scenes and understand their designs, it is, we are bound to admit, a fact that a considerable amount of confidence is still placed in these men. Should their assertion, so boldly proclaimed, that the American Government will not interfere with the Direct cable turn out to be merely another piece of bravado, a portion, if not all, of that confidence, will certainly vanish. On every ground the final decision of the American Government is therefore a matter we look forward to with the greatest possible interest.

THE Direct Spanish Telegraph Company is making progress. The accounts for the half-year ending June 30th—by the way, how is it that the directors have allowed three months to elapse before issuing their half-yearly statement?—show a balance to the credit of profit and loss of £3,599, as compared with £2,875 for the corresponding half-year of 1876. After providing for the half-yearly dividend on the 10 per cent. Preference shares, payable on the 1st October, the directors have a balance of £678 remaining, out of which, with the consent of the shareholders, they will pay 1s. 9d. per share on the Preference shares, 1s. 9d. being half of the arrears due on these shares. It will be a good thing when the arrears in question no longer exist. We observe with pleasure that no interruption of the Company's cables has occurred between January and June; and we also note with satisfaction, or should do if we held shares in the company, that the item disbursed for legal expenses in the profit and loss account is only £2 3s. 4d. We never recollect seeing such a small sum charged in the half-yearly account of a limited liability company before.

There is anything but tranquility in the board-room of the South Eastern Railway Company. Mr. Alfred Watkin, it appears, took into his head that he would like to be a member of Parliament—and he became a member of Parliament. But the directors of the South Eastern Company, or some of them, did not appreciate the greatness thrust upon, or achieved by, their *employé*. So they intimated that they should like to relieve him of his duties, and a valuable post became vacant. It was not surprising that the father of the blushing M.P., being also chairman of the South Eastern Company, objected to the suggested resignation of his son, and finally announced his intention of himself withdrawing from the chairmanship. The directors of the South Eastern Company wish, however, to retain the services of the father if they lose those of the son. Mr. Watkin's time could hardly, by any stretch of imagination, be said to have been at the disposal of the South Eastern Company since his election as member for Grimsby. On the other hand, Sir Edward has rendered great and valuable aid to the Company, and his retirement would be a matter of general regret. It can hardly be supposed, however, that the whole of the directors are to bow to the opinion even of their chairman, and unless Sir Edward can be induced to reconsider his decision, we fear the shareholders will be deprived of his advice at a somewhat critical period in the history of the Company.

Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Will you be so good as to inform me of the name and address of the publisher of Fontaine's "Lighting by Electricity," quoted in the JOURNAL for 15th ult., or state where it can be obtained in England?

In looking through some questions issued by the Science and Art department of South Kensington, I came across the following:—"When the two needles of an astatic pair are of perfectly equal strength, the needles set at right angles to the magnetic meridian, develop the mechanical reason of this deportment."

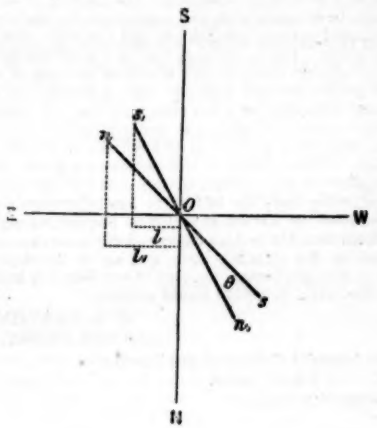
I was under the impression that a pair of needles so arranged would remain indifferently in any position. In Fleeming Jenkin's work (page 193) and Deschanel's "Natural Philosophy" (page 661), it seems to be so stated. If I am incorrect will you kindly put me right, and at the same time state why the pair of needles would so place themselves?

I am, Sir,

Your obedient Servant,

TELEGRAPHIST.

[The cause of an astatic pair of needles of perfectly equal strength setting at right angles to the magnetic meridian has been ascertained by Nobili to be due to the two needles not being exactly in the same vertical plane with respect to the axis of the system.



In the figure let $n\ s$ and $n_1\ s_1$ be the two needles making a very small angle θ with one another. If we suppose the equal forces at both ends of the needles tending to turn the latter into the same plane with the magnetic meridian to be f, then the static moment for the needle $n\ s$ will be $2\,f\,l_1$, and that for the needle $n_1\ s_1$ will be $2\,f\,l$. The force, therefore, acting upon the system will be—

$$2\,f\,l_1 - 2\,f\,l.$$

Now under the influence of this force the system will turn until—

$$f\,l_1 - f\,l = 0 \text{ or } l_1 = l$$

but this can only be the case when the angle θ becomes bisected by the line E W—that is, when both the needles are approximately at right angles to the magnetic meridian N S.

If the needles of the pair be not of exactly equal magnetic strengths and not of equal lengths, and their ends be not equidistant from the axis of the system, then the needle which has the greatest static moment will turn the whole system into the plane of the magnetic meridian. If, lastly, the conditions of the needles be the same in every respect, then the system will remain indifferently in any position.—EDIT. TEL. JOUR.]

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Signor Volpicelli published at the commencement of the year 1876 what he termed a new theory of electro-static induction, and in connection with which he described his experiments which led him to the conclusion, "If an insulated cylinder be acted on inductively by an electrified body, the free electricity found on the portion of the cylinder nearest the electric source is of the *same* character as that of the source. This is diametrically opposite to the assertion of the old theory."

In *Nature* for May 11, 1876, Professor Clerk Maxwell states clearly what is the true theory of electro-static induction, and how it differs from the erroneous one advanced by Professor Volpicelli. For the benefit, however, of those who may attach importance to Signor Volpicelli's "experimental facts," it may be well to show, which we believe has not been previously done, how it was that the experiments of this gentleman led him to false conclusions. In his experiments he really fell into the old mistake of confusing electric potential with electric density, since he uses for the purpose of measuring this electric density a *condensing* proof plane, that is, a small condenser, one coating of which is made to coincide with any portion of the surface of the cylinder under examination, and the other coating put to earth. But by the well-known laws of the leyden jar the charge taken by the insulated coating of this small condenser will measure the potential of the cylinder relatively to the earth, and not the electric density, and will, therefore, be practically the same, no matter with what portion of the cylinder it is put into contact. Consequently, if this *condensing* proof plane be applied to any portion of the cylinder opposed to the inducting body (or in fact to any other portion of the cylinder) we should expect it to acquire, as Signor Volpicelli found it to do, a charge of the *same* character as that of the inducing body, and *not* of the opposite kind, as this gentleman appears to consider the known laws of electric induction would require.

W. E. AYRTON.
JOHN PERRY.

The Imperial College of Engineering,
Tôkiô, Japan.
August 7, 1877.

IN answer to VOICES FROM THE INDIAN TELEGRAPHS, we may state that the omission of the paragraphs referred to by our correspondents is only apparent. In translating Deschanel's work, Dr. Everett found it necessary to make many important additions. These are indicated by a letter added to the number of the paragraph, as for instance, 480*a*, 480*b*, &c. The additional matter thus introduced rendered superfluous the paragraphs named by our Indian friends, and they were accordingly omitted. This omission does not, however, affect the completeness of the work in the slightest degree. For convenience of reference the paragraph numbers, so far as given in Dr. Everett's volume, have been made to correspond with those in the original.

The whole of the first notes, with the exception of those signed D., are from the pen of Professor Everett, and add materially to the value of the work.

By the courtesy of Messrs. Longmans & Co., we are enabled to state that a seventh edition of Mr. R. S. Culley's "Handbook of Practical Telegraphy" is in hand, the publication of which will be duly announced.

Messrs. Macmillan & Co., of Bedford Street, London, are the publishers of the Clarendon Press series. No doubt the works mentioned on Electricity and Magnetism can be obtained from them.—EDIT. TEL. JOUR.]

Patents.

2064. "A new or improved method of skating or bicycling, and in the application of magnetism thereto."—N. HORSTMAN, May 26, 1877.

2094. "Electric light apparatus."—A. M. CLARK (communicated by Lontin and Co.), May 29.

2131. "An electro-pneumatic method of ringing bells."—F. J. MONEY, June 1.

2194. "Galvanic batteries."—S. W. M. de SUSSEX and L. A. BRASSEUR, June 5.

2213. "Galvanic batteries."—A. de WATTVILLE and J. MAYER, June 7.

2240. "Improvements in telegraphic and electrical apparatus, parts of the invention being applicable to other purposes."—C. F. VARLEY, June 8.

2291. "Improvements in apparatus to be arranged in connection with gas pipes or burners for opening and closing the cocks thereof by electro-magnetism."—W. R. LAKE (communicated by D. Mc. C. Smyth), June 12.

2314. "Improvements in and relating to electro-magnetic motors."—W. P. THOMPSON (communicated by W. W. Gary), June 14.

2390. "Improvements in the application of electrical apparatus to traps and other receptacles for birds and animals for the purpose of opening and closing the same."—S. FYNN and C. CROPLEY, June 20.

2430. "Apparatus relating to the art of multiple telegraphy."—S. PITT (communicated by E Gray), June 22.

2449. "Electric telegraph apparatus."—J. W. BROWN, June 25.

2463. "Relays for electric telegraphs."—C. H. G. RISCH, June 26.

2480. "Improvements in apparatus used in galvanising sheet iron or coating sheet iron with zinc or alloys of zinc."—R. HEATHFIELD, June 27.

2509. "Means or apparatus for galvanising iron or coating it with zinc and tin."—F. BRABY and A. C. MOORE, June 29.

2538. "Electric telegraphs."—J. and A. MUIRHEAD, July 2.

2583, "Improvements in the construction and arrangement of lamps or apparatus adapted to the electric-light, parts of which are applicable to other lights."—W. PROSSER and W. E. MOORE, July 5.

2696. "Expeditious automatic telegraph, called 'expeditious automatic telegraph apparatus.'"—L. CARLANDER, July 12.

2880. "An arrangement of semi-automatic apparatus for transmitting telegraphic messages with the Morse system."—H. GARDNER (communicated by Le Comte E. Siccardi), July 27.

2889. "Electro-magnetic apparatus."—E. G. BREWER (communicated by J. N. H. Boucher), July 28.

2892. "Improved method and apparatus for stopping runaway horses, part of which apparatus is applicable for electrical machines generally."—F. ARUS (communicated by P. Rondel), July 28.

2909. "Improvements in instruments for controlling by sound the transmission of electric currents, and the reproduction of corresponding sounds at a distance."—T. A. EDISON, July 30.

2927. "Instruments for transmitting, recording, and receiving telegraphic messages."—T. A. EDISON, July 31.

3934. "Electric lamps."—A. M. CLARK (communicated by S. Marcus and B. Egger), July 31.

2982. "Improvements in electric lamps and in the manufacture of the electrodes used therein."—A. M. CLARK (communicated by E. Reynier), August 3.